

1,102,902



PATENT SPECIFICATION

DRAWINGS ATTACHED

1,102,902

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Date of filing Complete Specification: 2 June, 1965.

Application Date: 3 June, 1964. No. 22934/64.

Complete Specification Published: 14 February, 1968.

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Index at Acceptance:—F1 P (6K, 10X); E1 F10.

Int. Cl.:—F 15 b 1/00

COMPLETE SPECIFICATION

Hydraulic power supply systems.

We, AKTIENGESELLSCHAFT FÜR ANGEWANDTE HYDRAULIK UND FEINMECHANIK, a Swiss Company, of Bankstrasse 4, Glarus, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to hydraulic power supply systems for hydraulic actuators, and is particularly concerned with the problems involved in vehicle applications where hydraulic actuators are subject to occasional very heavy overloads. This occurs for example in the hydraulic actuators associated with a power-operated tool of a machine such as an earth-moving machine, or mechanical digger. When a part of the tool strikes an object such as a stone or tree trunk it is desirable that the force available from the actuators should be greatly increased.

A variety of complex and expensive solutions to this problem have previously been proposed, and it is an object of the invention to provide an improved hydraulic power system for a number of hydraulic actuators, especially on a vehicle, which will give an increased output force when desired, in a simple and effective manner, and without the necessity for installing a driving motor of high reserve power capacity. The invention is to be distinguished from hydraulic power supply systems of vehicle transmissions and the like, where totally different considerations apply.

From one aspect the invention consists broadly in a hydraulic power supply system for a plurality of separate hydrostatic actuators all associated with the same machine, such as the lifting and digging actuators of a hydraulic excavator, comprising a separate variable displacement pump associated with each actuator, the pumps being driven by an engine on the machine, individual adjusting means for setting the displacement of each pump, and automatic overload control means responsive to the engine load or power output, or to the output pressures of the pumps, or the pressures in the actuators, and acting on the pumps through proportioning means for altering simultaneously the displacement of each pump to an extent dependent upon the instantaneous setting of the individual adjusting means.

The invention is particularly applicable to such systems where the actuators are a reciprocating displacement motor, such as a hydraulic ram.

Each pump itself is preferably a rotary variable displacement pump, such as a swash plate or tilting-head pump, and is preferably of the reversible displacement type.

The invention also resides in a hydraulic system as defined, in combination with a common prime move, such as a diesel engine, having a substantially constant horsepower output, and arranged to drive all the pumps.

Furthermore the invention also consists in a vehicle, such as an earth-moving machine, or digger, having a power-operated working tool which is subject to overloads, and including a hydraulic power system as defined for operating the tool.

The invention may be performed in various ways and one specific embodiment will now be described by way of example with reference to the accompanying drawings, in which

Figure 1 is a diagrammatic illustration of a hydrostatic excavator to which the invention may be applied, and

Figure 2 is a diagrammatic illustration of a dual pump power supply system for two actuators, arranged to control the boom of the excavator.

In the example of Figures 1 and 2 the invention is applied to a power-operated digger having a main platform or turret

[Price 4s. 6d.]

mounted for rotational movement about a vertical axis on a chassis 11 which is propelled by endless tracks 12. Pivotaly mounted on the turret is a boom which includes inner and outer sections 13,14, connected at an articulating joint 15, and has at its extremity a further articulated member, such as a bucket or grab 16. Between the inner part of the boom and turret, and between each of the two parts at each articulation, there is provided a double-acting hydraulic ram, 17,18,19, for controlling the articulation of each joint. Each one of these rams, or in some cases, depending upon the design of the complete tool, a limited number of the rams, is subject in use to high overload forces when the bucket strikes an object which offers high resistance to movement.

Also mounted on the turret is a diesel engine 20 of a size sufficient to provide only the normal operating horsepower requirements, arranged to drive a number of variable displacement reversible hydraulic pumps 60 of the tilting head type. Such pumps are well known, and need no further description. The displacements of the pumps can be adjusted individually by a control unit 22, having manual control levers for operation by the vehicle driver, the output of each individual pump being connected to one of the hydraulic rams 17,18,19 referred to. Only two such pumps 60 are illustrated in Figure 2. Preferably other pumps, of constant displacement type, are coupled to rotary hydraulic motors arranged to control the rotation of the turret 10 on the chassis 11, or to drive the endless tracks 12.

As illustrated in Figure 2 the automatic overload control comprises an engine load sensitive device in the form of a pressure sensitive valve or capsule 55 incorporated in the mounting of the engine, so as to provide a torque-responsive signal when the engine becomes overloaded. This pressure signal is applied to a pressure piston 56 acting on a pivoted gate 57 in each pump housing, so that all the gates 57 move in unison and adopt a similar angular attitude. Each gate is provided with an elongated slot 58 in which slides one end 63 of a proportioning lever 59, the other end being attached to the respective tilting head pump 60, while an intermediate point is attached to a manual pump displacement controller 64, connected to one of the control levers on the control unit 22. The cylinder of the pressure piston 56 is also connected to the pump output passage of one or all the pumps, non-return valves 61,62, being fitted in this connection and in the connection to the pressure capsule 55. The piston 56 is thus sensitive either to an overload condition of the engine, or of any of the individual pumps. The movements of the piston 56 exert an effect on each tilting head pump which is propor-

tional to the instantaneous attitude of the respective proportioning lever, and to the instantaneous position of the gate. If the free end 63 of a lever is approximately at the centre of the slot in the gate, corresponding to zero pump displacement, the tilting of the gate when the engine becomes overloaded will exert no effect on that pump, whereas the greater the displacement of the lever end 63 from the central zero position the greater will be the displacement reduction effected when the gate tilts. Thus the displacement setting of all pumps will be reduced proportionally.

As a result the speed relationship between the individual actuators will not be affected when the automatic overload protector comes into operation, and therefore the path of travel of the bucket at the end of an articulated boom including two or more hydraulic rams will remain the same, and will much facilitate control of the machine by its operator.

The rate of movement of the bucket 16 or other operating head of the tool will of course be diminished accordingly, but in most such applications this is an advantage, since it provides more sensitive control.

It will be noted that since each pump is variable from full displacement in one direction through zero to full displacement in the opposite direction, the pump itself can be used to control the associated ram, without any intervening and expensive control and reversing valves.

WHAT WE CLAIM IS:—

1. A hydraulic power supply system for a plurality of separate hydrostatic actuators all associated with the same machine, such as the lifting and digging actuators of a hydraulic excavator, comprising a separate variable displacement pump associated with each actuator, the pumps being driven by an engine on the machine, individual adjusting means for setting the displacement of each pump, and automatic overload control means responsive to the engine load or power output, or to the output pressures of the pumps, or the pressures in the actuators, and acting on the pumps through proportioning means for altering simultaneously the displacement of each pump to an extent dependent upon the instantaneous setting of the individual adjusting means.

2. A hydraulic system as claimed in claim 1, in which each actuator is a reciprocating hydraulic ram.

3. A hydraulic system as claimed in claims 1 or 2, in which each pump is a rotary variable displacement pump, such as a swash plate, or tilting-head pump.

4. A hydraulic system as claimed in any of the preceding claims in combination with a prime mover, such as a diesel engine.

having a substantially constant horsepower output, and arranged to drive all the pumps.

5 5. A hydraulic system as claimed in any of the preceding claims, in which at least one of the actuators is a double-acting ram and the associated pump is a reversible variable displacement pump connected in a closed circuit with the actuator.

10 6. A hydraulic power supply system as claimed in any of the preceding claims, in which the automatic control means is responsive both to an overload condition of the engine power output and to an overload condition in at least one of the pump delivery
15 lines.

7. A vehicle such as an earth-moving machine or digger comprising a power-operated working tool having a plurality of hydrostatic actuators, and including a hy-

draulic system for operating the tool, as 20 claimed in any of the preceding claims.

8. A hydraulic power supply system for a plurality of hydrostatic actuators, substantially as described with reference to the accompanying drawings. 25

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COMPLETE SPECIFICATION

2 SHEETS

This drawing is a reproduction of
the Original on a reduced scale.

SHEETS 1 & 2

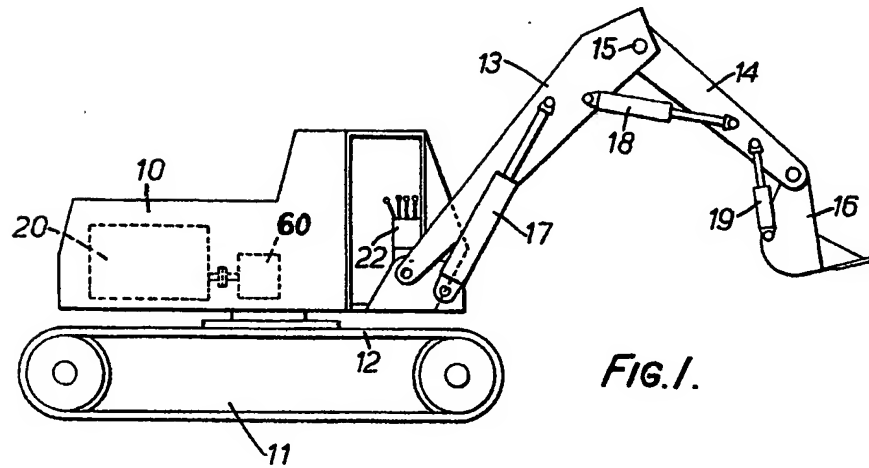


FIG. 1.

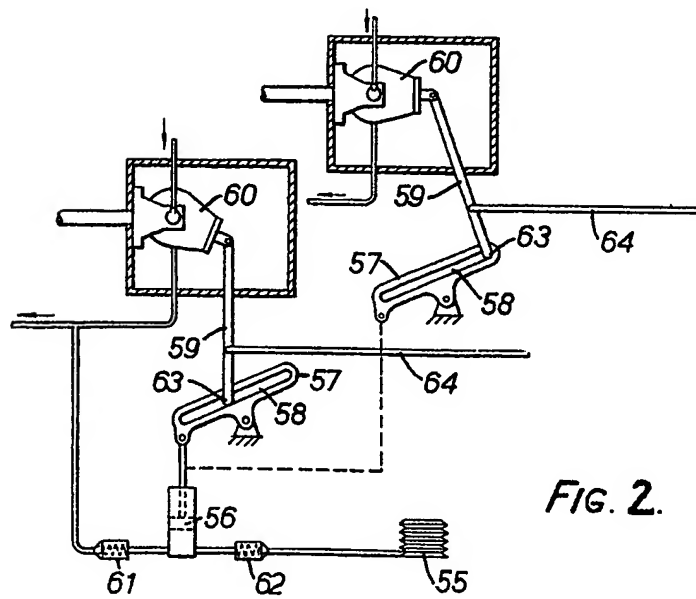


FIG. 2.